

## INTRODUCTION

Few upgrades are as effective as adding RAM to your PC. System memory is in great demand from the moment you switch on your PC, with each of the many tasks that make Windows work competing for memory. When there's too little to go round, your PC uses the hard disk as a substitute, and performance drops rapidly. If you find that your PC often accesses the disk even when you're not opening or saving files, adding memory should make it faster.

For the best performance in Windows XP we recommend a minimum of 512MB, but as computer memory used to be expensive, it's not unusual to see older Windows XP PCs with just 256MB. Good-quality RAM is now remarkably cheap. You can buy 1GB for just £50, but first you need to be sure that it will work in your PC.

In this month's *Upgrade Workshop*, we'll guide you through buying and installing the right memory for your desktop PC. In a future issue of *Computer Shopper* we'll cover notebook computers, which use different memory.

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# Memory

Adding RAM is a great way to boost your PC's performance – and it's an easy upgrade to perform, as Simon Handby explains

**DDR2 DIMM** DDR2 memory is the successor to DDR. DDR2 DIMMS have 120 connecting pins on each side, making a total of 240

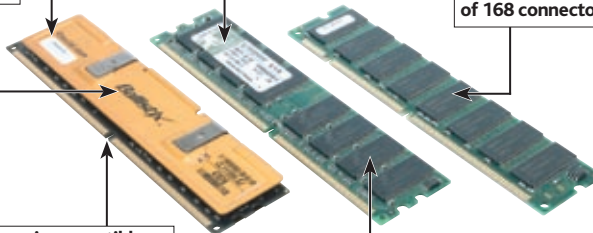
**STICKER** Nearly all memory sticks are marked with information on their speed and capacity

**SDRAM** Computers made as recently as 2003 may contain SDRAM. This slower standard has two notches, and a total of 168 connector pins

**HEAT SPREADERS** This high-end DDR2 memory has heat spreaders to aid cooling in fast PCs. They look good, but most RAM works fine without them

**NOTCH** Different RAM standards are incompatible, so memory sticks have notches that allow you to insert them only in the appropriate motherboards

**DDR DIMM** This memory type is prevalent in today's PCs. It has a total of 184 connector pins



**A** PC bought in the past eight years will use one of four different types of memory module. These are not compatible with each other, so it's essential that you know which type your computer uses. Even memory modules of the same type can have different performance ratings, and while it's fine to install memory that's faster than you need, you should never buy under-rated memory as it could make your PC slow or unstable.

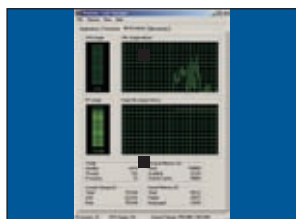
Most computers made between 1997 and 2001 use SDRAM memory running at 66, 100 or 133MHz. Only 133MHz (PC133) SDRAM chips are available today, but these are compatible with slower computers. Early Pentium 4 computers used either SDRAM or RDRAM memory, also known as Rambus. The latter never really took off and is expensive now.

From mid-2001, DDR memory became increasingly common in Athlon-based computers, and was used in Pentium 4 PCs from the beginning of 2003 onwards. DDR memory is freely available and very affordable, but it comes in a bewildering range of speeds and

specifications. Look in your motherboard manual for guidance on which speed you should buy. The minimum speed you need usually depends on the frontside bus (FSB) speed of the processor fitted in your motherboard. The vast majority of current processors have a 200MHz FSB, although this may be quoted as '400MHz effective' for AMD processors or '800MHz effective' for Intel processors. Such 200MHz FSB chips need PC3200 DDR memory. Current Intel Celerons typically have a 133MHz FSB (533MHz effective) and need PC2100 DDR RAM or faster. Socket A AMD Semprons have a 166MHz FSB (333MHz effective) and need PC2700 DDR or faster. Older processors may have even slower FSBs, but if you're in doubt, buy PC3200 memory as this is cheap and will work on slower buses.

Many expensive Intel desktop PCs now use DDR2 memory. This type of module has more connector pins than DDR and can run at a higher clock frequency. Like DDR memory, it's available in a wide variety of speeds. Your motherboard manual is likely to specify PC2-4200 DDR2 or faster.

## Compatibility checklist



### DO I NEED MORE MEMORY?

To check Windows' memory use, press Ctrl+Alt+Delete to run Task Manager in Windows XP, or select Run from Windows 98 or Me's Start menu and type 'rsrctr.exe'. These utilities tell you how much memory is in use. Also look for signs of low memory such as long load times, extensive disk activity and slow-downs.



### MEMORY TYPE

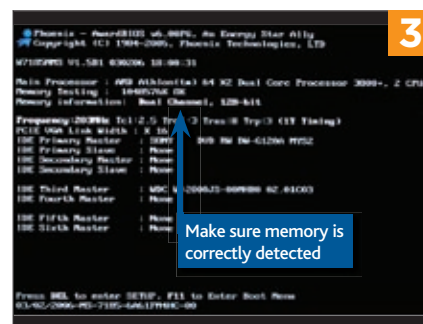
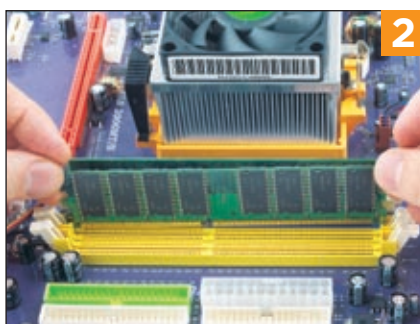
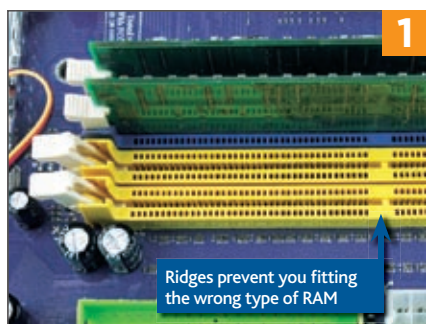
Before you buy RAM for your PC, find out which type it needs by checking the motherboard manual or looking at its existing modules. Alternatively, use the tools on memory manufacturers' websites, such as [www.crucial.com/uk](http://www.crucial.com/uk) or [www.kingston.com/uk](http://www.kingston.com/uk). If you don't know your motherboard model, you may need to open your PC's case and look for its label.



### CURRENT MEMORY

The amount of memory you can add depends on the number of slots, so look inside your PC. If you have no free slots, you will have to swap existing modules for higher-capacity ones. Don't buy bigger modules than your motherboard can handle. Windows XP can cope with 4GB, but Windows 95, 98 and Me may be unstable with more than 1GB of RAM.





If you're not sure what RAM to buy, try entering your system or motherboard model in the online configuration tools provided by major memory manufacturers – see our Compatibility checklist below for details. The System Scanner at [www.crucial.com/uk](http://www.crucial.com/uk) tells you your PC's current FSB speed, which can help you choose the right upgrade when your motherboard supports a range of different bus speeds.

Finally, look in your motherboard's manual to see if it supports a dual-channel mode. Such boards typically have memory slots arranged in coloured pairs, and will run slightly faster if each pair of slots contains identical sticks of memory. DDR and DDR2 memory is often sold in matched pairs for this reason. Most Rambus computers work only with matched pairs of memory. Your computer may have other specific limitations, so refer to the Compatibility checklist.

## INSTALLATION

Memory is easy to install, but it's very sensitive to static electricity and should be handled with care. Before you start, and every now and then as you work, touch the unpainted part of a radiator to discharge any static electricity that you may have built up. Always handle memory sticks by the edges of their circuit board and avoid touching the chips or any exposed pins.

### 1 PREPARE YOUR COMPUTER

Disconnect your computer's power and peripherals, and open the case. Lie your PC down so that the motherboard is parallel with the

surface you are working on. Locate the memory sockets on your motherboard, which are usually near the processor.

For easy access, you may need to remove any system components that are in the way, or cables that run across the top of the memory modules. On many motherboards it's hard to release the memory socket clips without first removing items that are in the way, but make a note of anything you move so that you can put it back later.

If you're replacing your existing memory, remove it from the motherboard by pressing down on the plastic retaining catches at each end of the memory slot. It's best to release both ends at once, checking for obstructions if the catches seem overly stubborn.

Each slot will have one or two plastic ridges along its length, as shown in the picture above, which stop you inserting the wrong kind of memory. Examine the slots carefully to find the position of the ridges, as you'll need to match them with the notches on your new RAM.

### 2 INSTALL YOUR NEW MEMORY

First you must decide which slots to use. On motherboards with dual-channel support, each channel's slots are usually the same colour and should contain identical memory sticks for optimum performance. Other motherboards may have two, three or four slots. You should usually fill these from the lowest-numbered

slot upwards, but your motherboard's manual will tell you exactly what to do.

Once you know which slots you are using, press down on the plastic catches at each end so that they pivot open. Carefully open the anti-static packaging of the first memory stick and find the notch or notches on its connecting edge. Being careful to handle it by the other three edges only, line it up with the memory slot, making sure the notches are in the right place.

Insert the memory stick by pressing it down at both ends. The two catches should clip over the ends of the module as it moves down into the slot. If you encounter a lot of resistance, check again that the notches are in the right place, and make sure the memory is lined up properly.

### 3 FINISHING OFF

Once you have installed the first memory module, use the same method to add any others. Check that the catches are properly engaged in each occupied memory slot and replace any components you removed, before closing the PC case and reconnecting your peripherals.

You should find that your computer starts

without any problems, but if it behaves unexpectedly consult the Testing and troubleshooting guide below. When you first switch your PC on, look at the information the system BIOS displays and check that the amount of memory it shows matches the total you expect. 

#### EXPERT TIP

Never use excessive force when fitting RAM, as you could break your memory or motherboard.

## Testing and troubleshooting

Having installed your new memory, look for an improvement in your PC's performance. If it was particularly short of memory before, you may notice from the first reboot that it loads Windows more quickly and is faster at everyday computing tasks. If you fitted more RAM to speed up memory-intensive software such as an image-editing program, run it to check that its performance has improved. You should be able to open more photos at once before your PC begins to crawl.

Most systems display a quick memory summary at bootup. Check that the installed memory and any memory speed or channel configuration information it reports matches what you expect to see. To give yourself time to read these messages, use the keyboard's Pause key, pressing the space bar when you have finished.

If you want to make sure your memory is working properly, visit [www.memtest.org/#downiso](http://www.memtest.org/#downiso) and download a suitable version of the Memtest86+ utility. Boot from the floppy

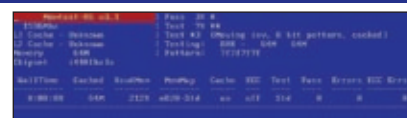
or CD-ROM you create and leave Memtest86+ running for at least one complete pass. Memtest86+ also displays useful speed and configuration information that can help you identify problems with your upgrade.

## TROUBLESHOOTING

Should your computer refuse to boot, retrace your steps and make sure your memory is inserted properly. Check that you have used the correct slots, and that you replaced or reconnected any components or wires you moved during the upgrade.

If you still can't boot your PC, make sure you've added memory in pairs if necessary, and that the memory you added is fast enough for your system. Check that you didn't add more memory than your motherboard can handle.

If that's not the problem and you added more than one module of memory, remove a module and try again. If your computer boots, switch it off again and swap in the module you removed to see if one is faulty.



▲ Memtest86+ can help you test memory for performance and faults

Should your computer's BIOS display the wrong total for installed memory, check that the memory sticks are correctly installed. If the total displayed is less than you have inserted, make sure you didn't add more memory than your motherboard can support.

If the memory speed displayed by Memtest86+ or your BIOS is slower than you expect, refer to your computer's manual for instructions on how to enter the BIOS and check the FSB speed.

If you have more than 512MB of memory and Windows 95, 98 or Me installed, you may experience instability. Visit [www.tinyurl.com/psdjd](http://www.tinyurl.com/psdjd) for details and a workaround.